REMARKS/ARGUMENTS

The Rejection of the Phraseology of the Abstract of the Disclosure under MPEP § 608.01(b)

The last O.A. rejected the abstract of the disclosure on the grounds of improper language. Accordingly, applicants have rewritten the abstract of their disclosure and submit that the abstract now complies with MPEP § 608.01(b).

The Rejection Of Claims 1-9 under 35 U.S.C. 112

The last O.A. rejected claims 1-9 under 35 U.S.C. 112 as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as their invention.

Accordingly, claims 1-9 have now been cancelled and new claims 10-16 have been substituted.

The Rejection Of Claims 1-9 under 35 U.S.C. 102(b)

The last O.A. rejected claims 1-9 under 35 U.S.C. 102(b) as being clearly anticipated by Ghosh et al. (U.S. 5,735,985).

Accordingly, new claims 10-16 have been written to define patentably over the cited reference. Applicants request reconsideration of this rejection for following reasons:

1. Ghosh et al. (U.S. 5,735,985) does not teach nor anticipate a method for making micromolds.

The critical difference between Ghosh et al. (U.S. 5,735,985) and the instant invention is contained in the titles of the respective inventions. Whereas Ghosh et al. (U.S. 5,735,985) describes a "Method For Molding Ceramic Structures", the instant invention describes a "Method For Making Micromolds".

Ghosh et al. (U.S. 5,735,985) does not claim a method to make micromolds and in fact does not make any use of this term throughout his disclosure. On the other hand, the instant invention now no longer claims a method to fabricate micromolded products. In the previous claim 1 of the instant invention micromolded products had been included but this claim has now been dropped.

Consequently, the process steps followed by Ghosh et al. (U.S. 5,735,985), viz.

providing a sinterable particulate ceramic material;
mixing the particulate ceramic material with thermoplastic material;
forming a micromolded green ceramic component from the compound;
extracting binder from the green micromolded component; and
sintering the micromolded component

have now become immaterial with respect to the instant invention as they all take place after a micromold has first been provided and have to do exclusively with the fabrication of Ghosh et al.'s (U.S. 5,735,985) end products, namely ceramic micromolded articles. It is clear that once a micromold has been provided it can, in principle, be used indiscriminately to mold many different types of moldable material compositions incorporating not just ceramic particulates but also metal particulates and either water-insoluble or water-soluble binders and either thermoplastic or thermosetting binders.

What is relevant then, is to compare the mold used by Ghosh et al. (U.S. 5,735,985) to produce his ceramic micromolded articles with the micromold of the instant invention.

The etched silicon wafer used by Ghosh et al. (U.S. 5,735,985) which he terms *master mold* cannot be used to produce his micromolded articles. This is because his silicon *master mold* is both costly to produce - requiring the capital-intensive investment and high cost operation of a wafer fab - as well as brittle, thus unable to withstand the cyclic stresses generated during compression molding of his ceramic micromolded articles. He therefore has to go through the additional process step of:

Ghosh et al. (U.S. 5,735,985) claim 1 (b):
forming a negative master mold from a micro feature replicating material using the master mold

Ghosh et al. (U.S. 5,735,985) then mounts this *negative master mold* on the bottom punch of a closed die with which his ceramic micromolded articles are produced by compression molding followed by sintering. Effectively therefore, the micromold - in the true sense of the term - used by Ghosh et al. (U.S. 5,735,985) is a closed die having a patterned bottom punch constituted by a silicone rubber casting of an etched silicon wafer.

The thickness of the master mold taught by Ghosh et al. (U.S. 5,735,985) is limited to the thickness of a silicon wafer.

Ghosh et al. (U.S. 5,735,985), col. 1, lines 61-64 reads:

Spatial features with a minimum lateral size from 0.1 μm to the silicon wafer thickness can be etched on silicon wafers and can be replicated by silicone rubber.

Silicon wafers are typically 500μm thick. Modern wiresaw technology has helped trim wafer thickness to as little as 200μm in order to increase the yield obtainable from silicon ingots.

The instant invention does not suffer from this thickness restriction, allowing design features with large aspect ratio, e.g. holes and pins with diameters of the order of the micrometer or smaller and depths/lengths of over 10mm.

The master mold taught by Ghosh et al. (U.S. 5,735,985) is of limited design complexity.

The silicon wafer etching process used by Ghosh et al. (U.S. 5,735,985) to produce his *master mold* is a uniaxial material abrading process. As a result freedom of design is restricted in the direction of the axis of etching. The *master mold* achieved by Ghosh et al. (U.S. 5,735,985) is essentially a thin silicon chip with platforms of different heights. Hence only simple design features are achievable. Design features such as rounded bosses, convex or concave domes, internal or external threads, undercuts, lateral holes and ribs, etc., are not feasible by etching. These limitations in design capability of the *master mold* taught by Ghosh et al. (U.S. 5,735,985) are mirrored in his *negative master mold* and thence in his ceramic micromolded products.

Ghosh et al. (U.S. 5,735,985) must overcome the shortcomings in design complexity of his *master mold* by sinterwelding separate micromolded parts, viz.

Ghosh et al. (U.S. 5,735,985) claim 2 (h):
sintering the first and second green elements while residing in the predetermined, contacting relationship.

On the other hand, the micromolds of the instant invention enjoy all the freedom of design offered by plastics injection mold design.

The master mold taught by Ghosh et al. (U.S. 5,735,985) is limited dimensionally.

Again quoting Ghosh et al. (U.S. 5,735,985), col. 1, lines 61-64:

Spatial features with a minimum lateral size from 0.1 μm to the silicon wafer thickness can be etched on silicon wafers and can be replicated by silicone rubber.

This size limitation of the etching process used by Ghosh et al. (U.S. 5,735,985) is inherently reflected in his *master mold* and *negative master mold* and further in his ceramic micromolded products. The instant invention does not have any limitations in minimum dimensions and can attain design features below 0.1μm.

Ghosh et al. (U.S. 5,735,985) does not teach a method to reduce the size of his master mold.

Ghosh et al. (U.S. 5,735,985) cannot handle shrinkage which is a bane to him. The silicone rubber compound he uses to cast his *negative master mold* cannot shrink appreciably otherwise the silicone rubber casting would seize around any core-type protrusions of his silicon *master mold* and the dimensions of the micro features of his silicon *master mold* would be altered in his *negative master mold.*

Ghosh et al. (U.S. 5,735,985), col. 2, lines 2-4:
Such material replicates each of the micro features of the master mold device in great detail to a resolution on the order of 0.1 μm.

Furthermore, Ghosh et al. (U.S. 5,735,985) also cannot handle shrinkage in his ceramic micromolded products.

Ghosh et al. (U.S. 5,735,985), col. 5, line 67 and col. 6, lines 1-6
The amount of shrinkage along any axis of the compacted powder form to that of the net shape ceramic should be less than about 0.001 percent in order to obtain close, predictable dimensional tolerances and produce the net shape ceramic of the invention. Such a part can then be put in its intended use without having to carry out a matching operation.

On the other hand, shrinkage management constitutes the very essence of the instant invention, allowing the micromolds of the present invention to be reduced in size with the only dimensional limitation being that of the particle size of the sinterable particulates used to produce them.

The past decade has seen significant effort in synthesizing particulate materials at the nanometer scale. Techniques such as the inert gas condensation (IGC) method enables production of powders without agglomeration with narrow size distributions and mean particle sizes in the range of 2-50nm. Such advances, combined with the teachings of the present invention, open unprecedented avenues for the fabrication of nanosystems which are clearly out of the reach of Ghosh et al. (U.S. 5,735,985).

Conclusion

For all of the above reasons, applicants submit that the specification and claims are now in proper form and that the claims all define patentably over the prior art. Therefore they submit that this application is now in condition for allowance, which action they respectfully solicit.

Conditional Request For Constructive Assistance

Applicants have amended the claims of this application so that they are proper, definite and define novel subject matter which is also unobvious. If, for any reason this application is not believed to be in full condition for allowance, applicants respectfully request the constructive assistance of the Examiner pursuant to M.P.E.P. § 2173.02 and § 707.07(j) in order that the undersigned can place this application in allowable condition as soon as possible and without the need for further proceedings.

Respectfully submitted,

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